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Exploration of novel subsurface microbial communities within seafloor mantle rocks

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Introduction: Ultramafic rocks in Earth's mantle represent a tremendous reservoir of carbon and reducing power. Mixing of these rocks with overlying seawater due to tectonic uplift causes an exothermic reaction known as 'serpentinization' that also releases hydrogen gas, methane, and small organic molecules.

The H_2 and CH_4-rich environments provided by serpentinization reactions are thought to be analogous to conditions found on the early Earth and perhaps other planets [1][2][3][4]. Much of what we know about the microbial communities living in seafloor serpentinizing environments comes from studies of the Lost City Hydrothermal Field (LCHF) chimney [5][6][7]. However, the chimneys cannot be accurate representatives of the deep, subsurface habitats within the Atlantis Massif where the LCHF is located because they are continuously exposed to oxidized seawater.

During October-December of 2015 the International Ocean Discovery Program Expedition 357 to the Atlantis Massif collected rocks from a subseafloor site of active serpentinization for the first time. This expedition recovered a total of 57 m of rock cores from 17 different drill holes into the Atlantis Massif with the aid of two seabed rock drills remotely operated from the ship. The drill holes were designed to capture rocks that span a range of degrees of serpentinization and varying distances from the LCHF chimneys.

One of the main goals of this drilling project is to generate a survey of the archaea and bacteria in marine serpentinite rocks by comparing the 16S rRNA gene sequences between the recovered cores of various holes with each other, to the background seawater, and to previous studies on carbonate chimneys at LCHF. For reaching this goal, two main questions of ***'Are there unique microbial communities associated with marine serpentinite rocks?'*** and ***'How can we distinguish the endemic microbial communities of subsurface serpentinite rocks from seawater residents?'*** will be addressed. A major challenge of this project is to obtain sufficient high-quality DNA from low-biomass serpentinite rocks for sequencing studies. Customized DNA extraction and purification procedures are currently being optimized for these sample types and to control for and identify contaminating DNA during all stages of sample processing.

Currently, almost nothing is known about the biology of the marine serpentinite subsurface. This research project will produce the first census of the di diversity, genomic content, and metabolic potential of microbes within the serpentinizing rocks collected from the Atlantis Massif.

References: [1] Schulte M. et al. (2006) *Astrobiology*. *6*, 364-376 [2] Martin W. et al. (2008) *Nature Review in Microbiology*. doi:10.1038/nrmicro1991, 1-10 [3] Mumma M. J. et al. (2009) *Science. 323, 1041-1045*. [4] Ehlmann B. L., et al. (2010) *Geophysics Research Lett*er 37: doi:10.1029/2010GL042596. [5] Schrenk M.O., et al. (2004) *Environmental Microbiology 6* 1086-1095. [6] Brazelton et al. (2006) *Applied and Environmental Microbiology 72,* 6257-6270. [7] Schrenk M.O. et al. (2013) *Review in Mineral Geochemistry 75,* 575-606.